



Lab Manual

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Chapter 8.8

CDE ResMap Four Point Probe

(cde-resmap - 380)

1.0 Title

CDE ResMap Four Point Probe Operation

2.0 Purpose

ResMap Four point Probe, made by Creative Design Engineering (CDE), is a semiautomatic tool to measure the sheet resistance of a thin film or the bulk resistance of a wafer/sample. The wafer/sample needs to get manually loaded onto the probe platform. Then the measurements are automatically controlled according to the selected recipe that is pre-programmed. It is capable of accommodating a wafer up to 12 inches in diameter. The maximum number of measurement sites available is 99, and the measurement pattern can be circular, rectangular, linear along the diameter of the wafer, or in a customized geometry. The measurement range is from $2 \text{ m}\Omega/\square$ to $5 \text{ M}\Omega/\square$ with 0.5% accuracy.

3.0 Scope

This document covers the procedures of sheet resistance measurement, and the explanations of the recipes.

4.0 Applicable Documents

ResMap Four Point Probe User Manual
Hard copy at the tool and soft copy stored in the PC.

5.0 Definitions & Process Terminology

- 5.1 **Four Point Probe:** A precision tool to measure the sheet resistance in a conductive media. The probe has 4 pins in contact with the conductive sample. Two pins apply a current and the voltage is measured across the other two pins. The sheet resistance can be calculated with the current, voltage and the geometry of the sample.
- 5.2 **Probe Configuration A:** Current flows through two outer pins (1, 4) and voltage measured across two inner pins (2, 3). This configuration has better signal to noise ratio.
- 5.3 **Probe Configuration B:** Current flows through pins (1, 3) and voltage measured across pins (2, 4). This configuration corrects for pin wobbling and can measure closer to sample edge.

6.0 Safety

Follow the general safety guidelines in the lab as well as the specific safety rules, as per follows:

- 6.1 **Electric Shock:** To prevent electric shock, do not change any switch settings and plug connections.

7.0 Statistical/Process Data

N/A

8.0 Available Processes, Process Notes**8.1 Available Programs:**

8.1.1 4" Wafers: 49, 25, 9, 5, 1 point and 17 point diameter measurements.

8.1.2 6" wafers: 49, 25, 9, 5, 1 point and 25 point diameter measurements.

8.2 Process Notes:

8.2.1 The probe installed is type A: Tip radius 40 µm, Force 100grams, Tip spacing 1.0 mm.

8.2.2 To copy the measurement results, use Windows Screen Shot (Alt+PrintScreen). First copy the screen display to the clipboard, and paste it to WordPad. Then you can use USB flash memory drive to transfer the file to your PC.

9.0 Equipment Operation**9.1 Equipment Description**

The Resmap Four Point Probe comprises of a probe station and a PC. Under the cover of the probe station, there is a wafer stage with concentric circular grooves for aligning wafers from 2 to 12 inches. The maximum measurement diameter is 8". On the out edge of the wafer stage, there is a rectangular ceramic for probe pin conditioning. Do not touch the ceramic to avoid contamination.

9.2 Measurement procedures

9.2.1 Enable the CDE ResMap Four Point Probe (cde-resmap).

9.2.2 Open the cover. Load and align your wafer/sample on the stage.

9.2.3 On the PC screen, click [Operator] drop down menu, then select [Run Recipe]. Select the Recipe you plan to use from the appropriate project ([section 11.1](#)). Click [ok] button. Or click [Previous] button to repeat the previous recipe.

9.2.4 The PC displays the Run Parameter screen. Enter the information on the left side of the screen for record keeping purpose. Ignore the Wafer ID field on right side of the screen, because the tool does not have a cassette loader.

9.2.5 Click the [Run] button and the tool run the selected recipe. When it finishes, the PC displays the raw data of all the measurements.

9.2.6 once the measurements are completed, you can use the graphic utilities to analyze/organize your data.

9.2.7 remove your wafer, and log out of the machine. with the cover closed.

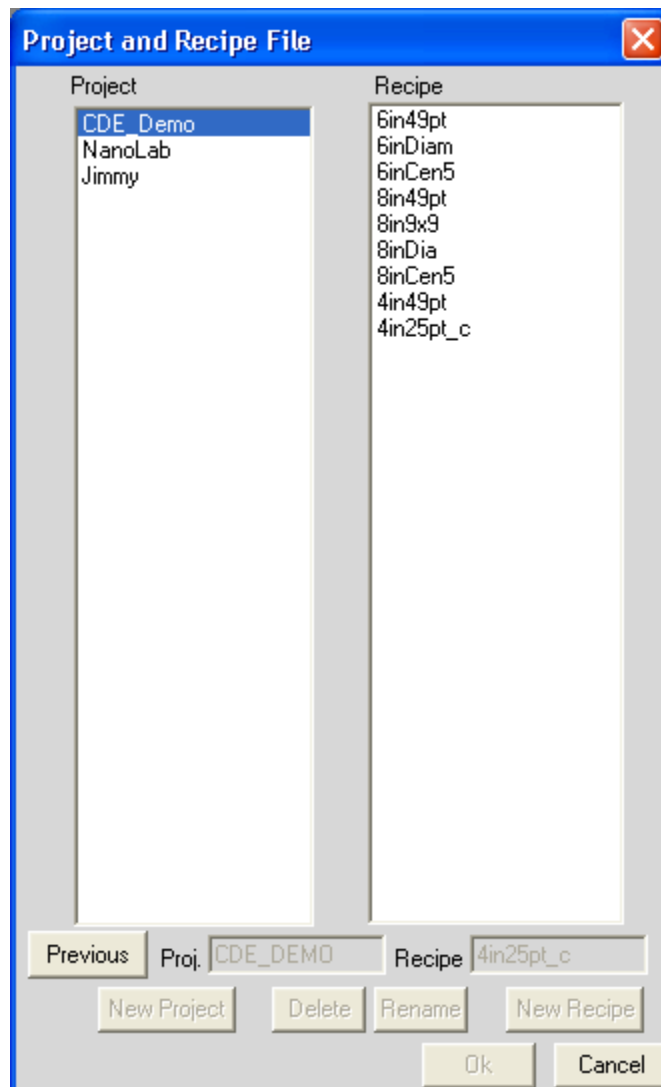
10.0 Trouble Shooting Guidelines

10.1 Problem: Pins not touching sample.

Cause: Measuring site is outside the sample. The sample may be misaligned or wrong recipe selected.
Solution: Re-align sample; select correct recipe.

11.0 Figures And Schematics

11.1 Project and Recipe selection screen



11.2 Run Parameter screen.

RUN PARAMETER: < CDE_Demo \ 6in49pt >

Run Titles:

Operator:

Engineer:

Equipment:

File Name:

Directory:

☐ Keep This Directory

SHEET (Rs)

Temperature:

Auto Print: ☐

☐ Condition Probe 1st

Wafers in Cassette

Select All

Desel. All

Slot #	Wafer ID
26	W#26
25	W#25
24	W#24
23	W#23
22	W#22
21	W#21
20	W#20
19	W#19
18	W#18
17	W#17
16	W#16
15	W#15
14	W#14
13	W#13
12	W#12
11	W#11
10	W#10
9	W#09
8	W#08
7	W#07
6	W#06
5	W#05
4	W#04
3	W#03
2	W#02
1	W#01

☐ Keep These ID's

Lot ID:

WaferID for manual load:

Note: All entries are for record keeping, no effect on measurements.

11.3 Sample Recipe screen (Engineer Menu)

RECIPE: < Jimmy \ 4inTest_49pt >

Wafer

☒ Round Diameter 100 ☐ Notch ☒ Flat Size 33

☐ Rectangular XSize 125 YSize 125

SHEET Conductor 550 Thk For BULK 550 Um AutoSampThk ☐

Measurement

Probe Configuration: ☒ Dual Probe Probe #1 ThOffset 1 ☒ Randomize

☐ Single Select

☒ Circular Area ☐ Rectangular Area ☐ Diameter ☐ Template

Sites 49 XII -55 YII -55 Angle 0 File Name Unused

#Sites/Band2 8 Xur 55 Yur 55 RStart -50 REnd 50

☒ StraddleNotch/Flat ☒ Follow Flat

Edge Excl 6 #X 5 #Y 5 dR 2

☐ EdgeExBoundary ☒ CutoffCorner #Sites 2

Data Conversion [Ratio] 1 Ohms/sq

0 Rs = 1 * [0 + 1 x Rs]

Temperature Compensations: P/N type ? Manual TCR 0 %/C

DataReject 6 Sigma Merit< 0.00 ReprobeAllRejects SPC Target 0 LCL 0 UCL 10

ConditionProbeBeforeReprobe

Motor 4pMot.prm MotionCoord 4pMtCrd.prm Probe 4pProbe.prm

PostProcess 4p_PostP.prm Run Title CDE ResMap

☐ Manual Load Only ☐ Skip Notch/Flat Find

Cancel Save Recipe Help

Note:

1. Conductor Thk for BULK field is used for BULK resistance measurement. It is not used for SHEET resistance measurement.
2. ThOffset field is the angle (in degrees) that the entire measurement map to be rotated. If the Randomize field is selected, the map will be rotated by a random amount less than ThOffset.

12.0 Appendices**12.1 Measuring the Film Thickness of a Metal Film**

The thickness of a metal film cannot usually be measured optically like a dielectric film because it is, in general, not transparent to light. The sheet resistance measurement can be used to calculate film thickness. If one assumes the film behaves like a bulk material (or the electrical and mechanical properties do not change in the film within the thickness range), then one can express the thickness as,

$$t = \rho / R_s$$

where t, is the thickness, ρ is the bulk resistivity, and R_s is the sheet resistance. Many films, however, do not behave nicely and ρ is not uniform within the thickness

of the film. If we assume that ρ decreases as a function of thickness buildup (typical within the first few hundred Å) then one can express the thickness (Å) as,

$$t = \rho' R_s^\beta$$

FILM	ρ'	β
Al	337.17	-0.92041

These values have been determined by SemiTech after much characterization.